

# Marine Physical Laboratory

AD-A280 834



15

## Geostatistical Traverse of EPR Natural Lab

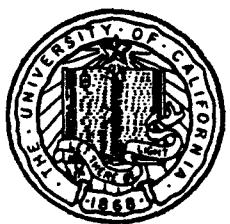
DTIC  
ELECTED  
JUN 2 9 1994  
S F D

Peter F. Lonsdale

Final Report to the  
Office of Naval Research  
Grant N00014-92-J-1614  
For the Period 06-1-92 - 09-30-93

MPL-U-3/94  
January 1994

*Approved for public release; distribution is unlimited.*



University of California, San Diego  
Scripps Institution of Oceanography

94-19800



94 6 22 150

| REPORT DOCUMENTATION PAGE   |   |   | Form Approved<br>OMB No. 0704-0188  |
|---|---|---|-------------------------------------|
| <p>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data need ed, and completing an<br/>this collection of information, including suggestions for reducing t<br/>burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson<br/>Place, Washington, DC 20503.</p>  |   |   |                                     |
| 1. Agency Use Only (Leave Blank).   | 2. Report Date.   | 3. Report Type and Dates Covered.                           |                                     |
|   | January 1994  | Final Report  |                                     |
| 4. Title and Subtitle.<br><br>Geostatistical Traverse of EPR Natural Lab  |   | 5. Funding Numbers.<br><br>N00014-92-J-1614                 |                                     |
| 6. Author(s).<br><br>Peter F Lonsdale   |   | Project No.<br>Task No.                                     |                                     |
| 7. Performing Monitoring Agency Name(s) and Address(es).<br><br>University of California, San Diego<br>Marine Physical Laboratory<br>Scripps Institution of Oceanography<br>San Diego, California 92152-5000  |   | 8. Performing Organization Report Number.<br><br>MPL-U-3/94 |                                     |
| 9. Sponsoring/Monitoring Agency Name(s) and Address(es).<br><br>Office of Naval Research<br>Ballston Tower One<br>800 North Quincy Street<br>Arlington, VA 22217-5660<br><br>Atten: Code 324GG  |   | 10. Sponsoring/Monitoring Agency Report Number.             |                                     |
| 11. Supplementary Notes.  |   |   |                                     |
| 12a. Distribution/Availability Statement.<br><br>Approved for public release; distribution is unlimited.  |   | 12b. Distribution Code.                                     |                                     |
| 13. Abstract (Maximum 200 words).<br><br>Support is requested for the collection, processing, and interpretation of marine geophysical data (multibeam bathymetry, sonar images, magnetic and seismic reflection profiles) on a 1200 km-long traverse of the East Pacific Rise. Objectives were to characterize the changing roughness of the oceanic crust as it ages from 0 to 10 Ma on both flanks and accumulates sediments, and to study the different geologic histories of the two flanks which have affected their relief and structure, and the pattern and structure of the present plate boundary. |   |   |                                     |
| 14. Subject Terms.<br><br>Multibeam bathymetry, magnetic and seismic reflections, East Pacific Rise   |   | 15. Number of Pages.<br><br>3                               |                                     |
|   |   | 16. Price Code.   |                                     |
| 17. Security Classification of Report.<br>Unclassified  | 18. Security Classification of This Page.<br>Unclassified | 19. Security Classification of Abstract..<br>Unclassified   | 20. Limitation of Abstract.<br>None |

# Geostatistical Traverse of EPR Natural Lab

**Peter F. Lonsdale**

**Final Report to the  
Office of Naval Research  
Grant N00014-92-J-1614  
For the Period 06-1-92 - 09-30-93**

|               |       |                                     |
|---------------|-------|-------------------------------------|
| Accession For |       |                                     |
| NTIS          | CRA&I | <input checked="" type="checkbox"/> |
| DTIC          | TAB   | <input type="checkbox"/>            |
| DRAFT SOURCE  |       | <input type="checkbox"/>            |
| Justification |       |                                     |
| By            |       |                                     |
| Distribution  |       |                                     |
| Dist          |       |                                     |
| A-1           |       |                                     |

---

## *Abstract*

Support is requested for the collection, processing, and interpretation of marine geophysical data (multibeam bathymetry, sonar images, magnetic and seismic reflection profiles) on a 1200 km-long traverse of the East Pacific Rise. Objectives were to characterize the changing roughness of the oceanic crust as it ages from 0 to 10 Ma on both flanks and accumulates sediments, and to study the different geologic histories of the two flanks which have affected their relief and structure, and the pattern and structure of the present plate boundary.

---

## *Introduction*

Much of the present geologic history of a spreading center can be interpreted from geophysical study of its rise flanks. Years ago it was realized that magnetic lineations and the azimuths of large fracture zones record the history of changing rates and direction of spreading. With the introduction of efficient high resolution survey tools, especially multibeam sonars, it became apparent that the shapes and patterns of medium-scale landforms, especially abyssal hills and volcanoes, contain far more information, especially on the history of rise crest segmentation. Reading the history of creation and extinction of transform and nontransform offsets, ridge propagation and offset migration, and changing patterns of magma supply, and relating this history to changes in external factors such as relative and absolute plate motion, is proving a key to understanding dynamic processes at rise crests. Also, once the geologic history of a rise has

been determined, by collecting critical data on carefully located but widely spaced tracks, a much more detailed prediction of the topography of unsurveyed parts is possible.

---

### *Research Objectives*

---

The goal of this project was to use wide-spaced swath mapping sonars, with ancillary magnetic, gravity and seismic data, to establish the geologic history of a spreading center, and then to use that history to make quantitative predictions of the rise flank relief. This project investigated the history of the 9° N East Pacific Rise, and quantifying how that history has affected the medium-scale relief. The fully equipped ship (*Melville* with Sea Beam 2000, seismic profiler, magnetometer, etc.), manned by the P.I. and his associates, made a transit of the EPR between Clipperton and Siqueiros fracture zones, from 10 Ma crust on one flank, across the axis, to 10 Ma crust on the other flank. On the central 30% of this transect the data swath crossed the already surveyed (Sea Beam Mk.1; SeaMarc 2) ONR Natural Laboratory, where the history is well established. The objective was to obtain quantitative comparisons of the relief measured by the different swath mapping tools, and by the MPL Deep Tow multibeam (which collected data from small patches along the transect, earlier in 1992). Beyond the existing crustal-age boundaries of the Natural Laboratory, the data was analyzed for the following purposes:

1. To establish the crustal-age: sediment-thickness relationship for both rise flanks, so as to make additional seismic profiling unnecessary on future cruises.
2. To aid planning for future surveys by establishing at what age (probably about 7 Ma) abyssal hills change azimuth and become highly oblique to the present rise crest. This is a key indicator of how long the EPR crest has maintained its present pattern, and hence an important datum for investigating how the rise evolved to this pattern.
3. To conduct a slope distribution analysis, mainly by student H. Mayer using the statistical techniques of D. Smith and P. Shaw, repeating the analysis we recently did of a Costa Rica traverse. We will be particularly interested in how once -identical crust (accreted at the same time and place on the rise crest) now differs in morphology after moving down the east and west flanks and experiencing the different off-axis tectonic and sedimentary histories of the Pacific and Cocos plates.
4. To do a variogram analysis of the scales of abyssal hill roughness and how they vary with age, using statistical techniques.

---

***Research Results***

---

Bathymetric data of excellent quality was obtained with the new Seabeam 2000 sonar, and was used for objectives 2-4 of the previous paragraph. Seismic profiles and 3.5 KHz profiles are adequate for objective 1. The slope distribution and variogram analyses are consistent with qualitative interpretation of the variations in amplitude, linearity and wavelength of the abyssal hill relief, and these analyses will be published as part of the analysis and interpretation of the much larger data set collected from this region in 1994. The project proved most valuable as a pilot program for this larger study.

## **ONR/MPL REPORT DISTRIBUTION**

**Office of Naval Research (3)**

Department of the Navy

Ballston Tower One

800 North Quincy Street

Arlington, VA 22217-5660

Atten: Joseph H. Kravitz

Code 324GG

**Administrative Grants Officer (1)**

Office of Naval Research

Resident Representative

University of California, San Diego, 0234

8603 La Jolla Shores Drive

San Diego, CA 92093-0234

**Commanding Officer (1)**

Naval Research Laboratory

Atten: Code 2627

Washington, D.C. 20375-5320

**Defense Technical Information Center (4)**

Building 5, Cameron Station

Alexandria, VA 22304-6145